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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,593	12/15/2003	Srivatsa Kundalgurki	543822003300	1431

25227 7590 05/26/2005

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EXAMINER	
PERT, EVAN T	

ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 05/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/734,593	KUNDALGURKI, SRIVATSA	
	Examiner	Art Unit	
	Evan Pert	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 March 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 9, 10,12 and 16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 9, the limitation "a lithography mask consists of a hard mask" is a disjointed limitation that has no recited relationship to the parent claim, which renders claim 9 ambiguous. Certainly, "a lithography mask" *somewhere* "consists of a hard mask" [specification, p. 1, lines 13-21].

Regarding claim 10, the limitation "a hard mask consists of carbon" is a disjointed limitation that has no recited relationship to the parent claim, which renders claim 10 ambiguous. Certainly, "a hard mask" *somewhere* "consists of carbon" [e.g. "prior art" carbon hard mask 12].

Regarding claim 12, the limitation of "a liner..." that "...is deposited," renders the meaning of dependent claim 12 incorporating parent claim 1 ambiguous. The phrase "from a liner on" of the preamble of claim 1 is ambiguous in view of claim 12 where "***a*** liner comprising of SiON" is deposited. For purposes of examination, the phrase "from a liner on" in the preamble of claim 12's parent claim (i.e. claim 1) is given insignificant patentable weight. For purposes of examination, the preamble of claim 1 is interpreted as being "a method for removing a resist from a mask on a semiconductor substrate."

Regarding claim 16, there is a lack of antecedent basis for "the resist mask." For purposes of examination, "the resist mask" in claim 16 is interpreted as being "the resist" of which the method in claim 1 is directed at removing (i.e. "a resist" in the preamble to claim 1 is considered as the intended antecedent basis for "the resist mask" in claim 16).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-3 and are 6-16 rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admitted Prior Art [i.e. "AAPA" consisting of Figures 1 through 3, with explanatory text at pages 1 through 2 of the specification] in view of Hopper et al. (US 6,030,901):

Regarding claim 1 (as well as depending claims 2-3 and 6-16), AAPA discloses a known "prior art" problem occurring when removing photoresist [not shown per p. 2, line 2] from a liner 13 on a carbon hard mask 12 on a silicon semiconductor substrate 10, including etching the resist off of the liner overlying the mask by providing an etching plasma at a predetermined temperature level and a predetermined temperature level [p. 2, lines 1-17].

The limitation of "for a predetermined amount of time" in claim 1 is not interpreted as having significant patentable weight: All etching is for some time period based on known etching rates and material thicknesses, even with an etch stop, so all etching is performed for some kind of "predetermined amount of time" such as including "at least for...such and such time" or for "X seconds," etc.[Official Notice].

With respect to claim 1, AAPA is only silent about the plasma "comprising at least hydrogen."

Hopper et al.'s invention is for "removing photoresist" from "a wide variety of carbon-containing materials which undergo degradation and/or removal during [conventional oxygen plasma ashing] photoresist stripping" [col. 5, lines 13-18] (wherein the AAPA SiON liner problem *analogously* relates to unwanted etching of carbon-containing SiON and/or etching of carbon hard mask material through failures in weaknesses of the SiON liner).

Hopper et al. explains that oxygen plasma is advantageously replaced with a hydrogen plasma of about 4% to 5% hydrogen, for example [col. 4, lines 50-63], to avoid the degradation and/or removal of carbon-containing materials underlying a photoresist mask being stripped that would occur such as in AAPA Fig. 2.

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to adopt "at least hydrogen" to provide an etching plasma for etching away photoresist of applicant's AAPA, motivated to avoid degradation of the underlying carbon-containing mask and/or liner of AAPA [col. 5, lines 13-24 of Hopper et al.].

Regarding claim 2, nitrogen dilutes the hydrogen of the etching plasma [abstract].

Regarding claim 3, the ratio of nitrogen to hydrogen is varied "depending on a particular situation" such as from 4 to 5% hydrogen in one embodiment, varied to 1 to 10% hydrogen in other embodiments [col. 4, lines 50-63].

Regarding claim 6, the etching plasma is free of oxygen [e.g. col. 4, lines 7-9 with col. 3, lines 5-12].

Regarding claim 7, the pressure is in the range of 50 to 300 Pa because the pressure is "about 1,200 mTorr" (i.e. 160 Pa) [col. 4, line 63].

Regarding claim 8, the predetermined temperature is "in the range of 150°C to 350°C" because "embodiments include heating to "about 250°C" to "improve photoresist stripping efficiency" col. 4, lines 10-13].

Regarding claims 9 and 10, the AAPA carbon hard mask is a photolithographically defined mask defined by a photoresist mask [p. 1, lines 13-21].

Regarding claim 11, the AAPA photoresist and the resists of Hooper et al. are necessarily "carbon-based" because they are "organic resists" [col. 3, line 2].

Regarding claim 12, AAPA indicates liner 13 is "preferably" choosen as "SiON."

Regarding claim 13, the substrates are Si substrates in AAPA (10) and in Hooper et al..

Regarding claim 14, the resist has a selectivity very high compared to the mask, which is well known as desirable for stripping a resist from a mask, and since the plasma composition disclosed by Hopper et al. has hydrogen in the amount prescribed by applicant's invention, must necessarily be at least as selective, with one of ordinary skill in the art changing ratios to get the highest selectivity at the direction of Hooper et al. (col. 4, lines 55-63].

Regarding claims 15 and 16, the "photoresist mask 13" is "removed" with a plasma comparable to applicant's plasma composition recited in claim 1. Therefore, the removal is reasonably interpreted as "completely stripped" and also has 0% non-uniformity because it is zero thickness throughout.

4. Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admitted Prior Art in view of Hopper et al., as applied to claim 1 above, and further in view of Waldfried et al. (US 6,630,406 B2).

Hopper et al. and Applicant's Admitted Prior Art does not suggest adding CF_4 to an oxygen-free hydrogen-containing plasma to remove photoresist from a wafer, yet Waldfried et al. discusses the benefits of adding a small amount of CF_4 (i.e. less than 5%) to the plasma comprising hydrogen [e.g. see "Example 1"].

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to adopt a predetermined amount of CF4 to the plasma containing hydrogen for removing photoresist taught by Hopper et al., motivated by the findings of Waldfrieds et al., that a plasma mixture of hydrogen, helium and < 5% CF4 "removes substantially all of the photoresist, polymers and post etch residues remaining on the substrate after etching" [col. 7, lines 28-31].

Response to Arguments

5. Applicant's arguments with respect to claims 1-16 have been considered but are moot in view of the new grounds of rejection set forth in items 1-4 above.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 6,492,272 is cited for disclosing the ashing of photoresist using a plasma "comprising at least hydrogen."

US 6,562,700 is cited for disclosing the use of reducing gas rather than oxidizing gas for an etching plasma for etching away photoresist "results in less damage" and "has better etch selectivity" [col. 5 line 20 to col. 6, line 15].

The article to Williams et al. is cited as a background to etch selectivity in the art of fabrication of integrated circuits, wherein "etch rate of each material to be etched must be known" and "knowing the etch rates enables a process to chosen for good selectivity," which are well known concepts to those understanding the disclosure of "etching a resist" from an underlying layer that can be damaged by the etching procedure.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 571-272-1969. The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ETP
May 24, 2005

EVAN PERT
PRIMARY EXAMINER